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A STUDY OF MEASURING METHODS FOR NITROGEN OXIDES IN THE AIR*

Kazunori Mitani**

Purpose

The Saltzmann method is currently used frequently as a method of measuring the nitrogen oxides in the air. However, there are many debates concerning its coefficient (the transformation coefficient from NO_2 to HNO_2), and the absorption and coloration mechanisms, also, are not yet clear. Studies were made of these points in comparison with the Hygiene Testing Method. Since several findings were obtained, the results are reported.

Experiments and Discussion

Standard NO_2 gas was diluted and used as the sample gas.

The reagents for the Hygiene Testing Method were:

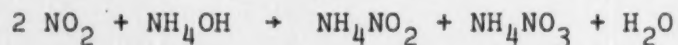
- 1) 0.01N NH_4OH ;

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- ii) 1% sulfanilamide hydrochloric acid solution;
- iii) 0.1% N-1 naphthylethylenediamine solution.

The equation for the absorption reaction of NO_2 is:



When reagents i), ii), and iii) were mixed according to the final reagent composition of 10 : 1 : 1 of the Hygiene Testing Method and made to absorb NO_2 , there was a far higher coloration than that in the Hygiene Testing Method. The coloration was approximately the same as that in the Saltzmann method. It is believed that this can be explained by the fact that either reagent ii), reagent iii), or both reagents ii) and iii) operated so that a reaction other than that in the equation above occurred, resulting in the high coloration.

When an absorbent liquid was prepared by mixing reagent ii) or iii) in reagent i) at a rate of 10 : 1, the following results were obtained in NO_2 absorption. When reagent ii) and i) were mixed together, the results were approximately the same as when i) alone was used. However, the absorbent liquid obtained by mixing reagent iii) and i) displayed an extremely high value. The coloration was even higher than in the Saltzmann method, and it was approximately twice that in the Hygiene Testing Method.

Consequently, it was learned that N-1 naphthylethylenediamine has a great effect in the absorption and coloration of NO_2 . In addition, comparisons were made with other absorbent liquids consisting of reagent i) to which various types of reduction type substances were added. In every case, the coloration was higher than when reagent i) alone was used.

Since N-1 naphthylethylenediamine has already been added to the Saltzmann reagent, it is believed that the coefficient is higher than 0.5 (ordinarily, it is said to be 0.72) on account of the effects of this substance.

Next, reagent 1) and a mixture of reagents 1) and iii) were used as absorbent liquids in tests of atmospheric air. A comparison of the results showed that, contrary to the results of experiments for standard NO₂ gas, there were cases when the mixed absorbent liquid consisting of both 1) and iii) displayed lower values than when reagent 1) only was used. The same results were obtained also in experiments with sample gases consisting of standard NO₂ gas to which ozone had been added. It is believed that this signifies that N-1 naphthylethylenediamine is destroyed by oxidizing gases such as oxone, the subordinate reaction proceeds, and the coloration deteriorates as a result.

A comparison of the Hygiene Testing Method and the Saltzmann method for standard NO₂ gas showed that approximately the same values were obtained in both cases. However, in simultaneous comparisons in the atmosphere, the Saltzmann method often produced lower values.

From the above, one may conclude that N-1 naphthylethylenediamine and reduction type substances enhance the absorption of NO₂. However, it was also found that when the sample gas is not pure NO₂, but other oxidizing gases such as ozone are also present, lower values are displayed. On this basis, it is believed that the Saltzmann method itself is exposed to the influence of oxidizing gases or other gases, and that this is probably the reason its coefficient is variable.